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Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

Rust Prevention by Use of Slushing Materials

PUBLISHED BY
THE TEXAS COMPANY
TEXACO PETROLEUM PRODUCTS

TEXACO IN THE SLUSHING AND RUST PROOFING OF STEEL

TEXACO No. 511 Oil . . . . A straight mineral oil, of 200 seconds viscosity at 100°F., for use where storage and shipping conditions are ideal.

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Rust Prevention by Use of Slushing Materials

RUST prevention is an extremely important problem wherever sheet steel, machine parts, or machinery, as a whole, are to be stored, handled, or operated with the utmost economy. The annual cost of rust to industry, could it be accurately determined, would probably amount to an amazing sum.

Rust does not always render a piece of steel or an operating mechanism incapable of subsequent usage. In some instances, however, rust must be absolutely prohibited. An anti-friction bearing or a steel file are not salable, if rust has formed thereon; to get down to daily life, neither is a steel shaft golf club.

Machinery, in turn, which must stand by, or be held inoperative over certain periods of the year, must likewise be protected against rust. Calendering operations, for instance, in textile, rubber, or paper mill service cannot be effectually performed if the surfaces of the calender rolls have become pitted on account of rust or corrosion. The same holds true for steel mill rolls, marine machinery, and other types of service where variations in temperature and considerable moisture may markedly accelerate rusting.

Rust prevention is a major problem to the steel industry wherever sheet steel is rolled to any specified gage for subsequent forming by pressing or drawing, as in the manufacture of automobile bodies or the cases of electric refrigerators.

THE CAUSE OF RUST

Rust is the result of oxidation (at normal temperatures) in the presence of moisture. It is important to remember that the latter must be present for there can be very little reaction between oxygen and iron or steel (at these temperatures), if the surface of the metal is absolutely dry.

THE IMPORTANCE OF DRY SURFACES

This point cannot be over-emphasized, especially when one is concerned with the manufacture of hardware tools, or in the handling of steel sheets for metal-forming purposes. In the course of production of such materials, they often come into contact with moisture in one form or another; this moisture, of course, should be completely removed from the steel before slushing oil is applied if freedom from rust formation is to be assured.

The presence of moisture may be due to incomplete drying after an operation in which water is used, or it may be caused by condensation of moisture from the air, especially in a humid atmosphere where normal temperature changes take place. Moisture is especially apt to be present where the drying operation is carried out by direct contact with live steam. Under such conditions, a final treatment with hot dry air would be more effective in removing the last traces of moisture. *It is important to remember that as long*

as the metal can be kept warmer than the surrounding air, moisture will not condense thereon from the atmosphere.

The next step after completely drying the surface is to treat the steel with a suitable rust preventative which will completely coat the surface, and prevent any possibility of wetting by moisture while being held in storage.

THE DETRIMENTS OF RUST

Rust at best is unsightly, and, as already stated, it will reduce the sales value of virtually any iron or steel articles on which it has formed even though the pitting which may have occurred has had no material effect upon the size or strength. In the steel industry however, rust may materially affect the ability of sheet steel to take lacquer or enamel. So in this industry, it is especially important to prevent rusting after the sheets have been rolled, and during the time they are being stacked, packaged, and delivered to the consumer. If this objective is not attained, it is probable that the steel in question will be returned to the mill as not acceptable. Obviously, this becomes a costly procedure to all concerned.

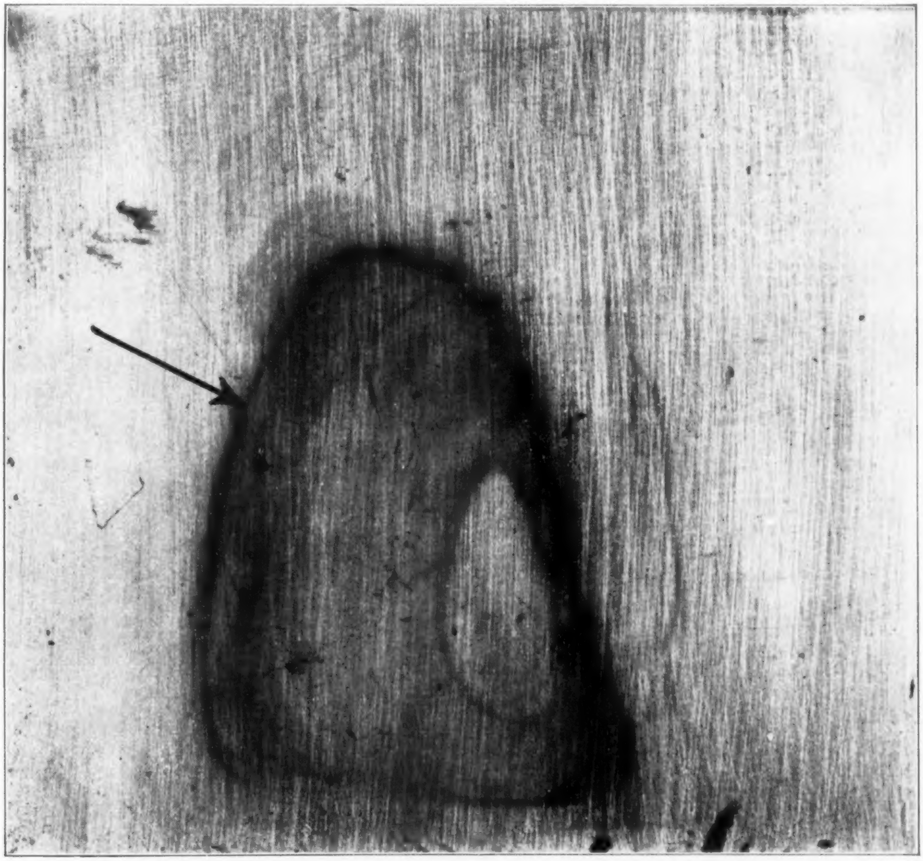

Fig. 1—Showing Type No. 1 rust formation. Arrow indicates rust which has formed on an "island" or bare spot. Note the shape assumed by this type of rust formation.

MATERIALS FOR RUST PREVENTION

Rust can be prevented by coating steel (when dry) with a protective film of petroleum base. In the petroleum industry, we refer to such materials as slushing oils. Over the course of time, a wide variety of slushing oils have been used. Investigation of the composition and rust-preventing ability of many of these compounds has been the basis of some very interesting research recently. Coincident with this work it was necessary to identify the various types of rust which may form on a steel surface. Each type of rust or corrosion had to be isolated, its cause investigated, and means of prevention developed.

STEEL MILL PROCEDURE

Most of the immense tonnage of sheet steel, which goes into the manufacture of automobile

bodies, electric refrigerators, etc., has slushing oil applied for its protection during storage and shipment. In the mill, extreme care is taken to prevent rust. Sheets are oiled and piled up in stacks one or two feet high, bound with metal bands, and then wrapped tightly with waterproof paper. They are shipped to their destination, usually in open gondolas or in box cars.

In some mills, a small percentage of steel sheets are shipped dry with no protective oil coating. Dry steel is apparently necessary in some instances where it is to be enameled or

Fig. 2—An example of Type No. 2 rust formation, viz., a faint film of rust covering most of the steel sheet surface. The arrows indicate area of heaviest formation.

plated, due to the difficulty in removing all traces of oil. Shipping steel dry, however, has disadvantages since lack of lubrication between the sheets may cause scratching, also rusting, due to lack of protection against moisture. Special methods of wrapping and shipping are necessary when steel is shipped in this way, thus increasing the expense.

WHAT THE SLUSHING OIL SHOULD BE

The ideal slushing oil for use on a steel surface should:

1. Be easy to apply.
2. Give maximum protection against rusting.
3. Be easy to remove when protection is no longer required.

These requirements are most usually met by oils of low viscosity, ranging from 35 to 250 seconds Saybolt Universal at 100 degrees Fahr.

WHAT IT MUST DO

A slushing oil has three functions when applied to steel shapes, sheets, or coils, i.e.:

1. To prevent rust formation on the surfaces during shipment and storage.
2. To furnish lubrication between the metal layers to prevent scratching or marking of the surface during the normal rubbing which takes place in shipment.
3. To provide, in some cases, a lubricant for the subsequent drawing operation in the plant where steel is processed.

Slushing oils as generally used will fall into two broad classifications:

1. Straight mineral oils.
2. Special rustproofing oils of petroleum base.

STRAIGHT MINERAL OILS

These products are usually well-refined lubricating oils containing no fatty oils or other added materials. Either paraffin or naphthene base oils can be used with equal results. These oils are the cheapest, and, therefore, the most widely used in the steel industry. They furnish good lubrication between the metal sheets. However, plant observations have shown that under some conditions they do not give complete protection to the steel against rusting in the presence of moisture. Water coming in contact with the steel, even after it has been oiled, will tend to penetrate a straight mineral oil film, wet the surface, and the steel will begin to rust, often in a few hours.

Straight mineral oils for rust prevention service range in viscosity from 85 to 250 seconds Saybolt Universal Viscosity; the average is about 100 seconds at 100 degrees Fahr. Oils above 250 seconds in viscosity are not generally used in the steel mill because of the fear that added lubrication might cause "slips" or "skids" while stacks of sheets are being transported in the mill before they are wrapped.

Many bad accidents have been caused on this account.

Fig. 3a—Above are shown white streaks caused by lime salts. These are preliminary to Type No. 3 rust formation.

Fig. 3b—Showing the rust marks which form under the white salt streaks as indicated in Figure No. 3a.

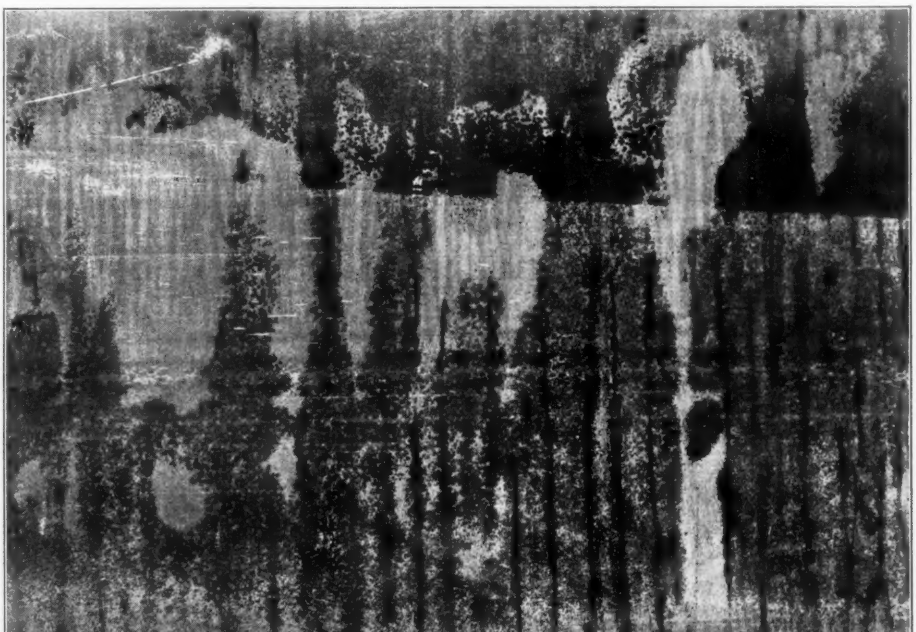

Fig. 3c—Here is shown an extreme example of Type No. 3 rust formation. Note how the streaks of rust run in the same direction.

In some mills the storage rooms where finished steel is stored are heated, and kept at approximately 75 degrees Fahr., all winter, great care being taken to keep steel from drafts of cold air in order to prevent moisture condensation. Under these conditions, there is

little difficulty with rusting where straight mineral oils are used. If, however, unwrapped steel is exposed to normal temperature variations for any length of time, rusting will occur. In that case, straight mineral oils give but little protection; here slushing oils with greater rust-resisting qualities are desirable.

Fig. 4—Showing the typical manner in which stacks of steel sheets are arranged for handling and storage. It is on stacks of this nature that a heavy coating of rust, Type No. 4, is often formed on the outsides if they are exposed to normal variations in temperature and humidity, if they have not been properly coated with a protective rust-proofing compound.

SPECIAL RUST-PROOFING MATERIALS

These products are composed chiefly of low viscosity petroleum lubricating oils or volatile thinners mixed with smaller amounts of other materials, the purpose of the latter being to give protection against rust. When a thinner is used, it acts as a solvent to carry and uniformly spread the rust-preventing material. The special rust-proofing oils used for slushing steel sheets usually range in viscosity from 35 to 250 seconds Saybolt at 100 degrees Fahr. Other more viscous products of the nature of light greases or petrolatums are also used for coating the outside of stacks of steel sheets, coils, and certain other steel materials.

The materials which are sometimes added to the special rust-proofing oils are of the following general nature:

1. Fatty compounds of various kinds.
2. Soaps soluble in water.
3. Soaps not soluble in water.
4. Metallic compounds (organic).
5. Mineral oil derivatives.
6. Halogenated materials.

All these added materials, if present in sufficient quantities and if prepared in the proper manner, will impart rust-proofing qualities to the oils. Some of them, however, are much more effective than others, and some, while giving a certain amount of protection against moisture, have a tendency to develop corrosiveness, which, after a long period of storage, will attack metal.

Lanolin, lard oil, and other fatty oils give slushing oils greater properties of adhesion to the steel. They also tend to form emulsions with any moisture that may be present, thus keeping the water from wetting the steel, thereby preventing rust. Some fatty oils, however, upon long contact with metal are not entirely stable; they tend to oxidize, forming fatty acids which may after long storage corrode the metal, and cause yellow designs to form over the surface.

By special treatment, certain of these products can be made very resistant to oxidation; they have been found quite satisfactory over long periods of storage.

Soaps which are soluble in water are of value in that they will emulsify with any moisture coming into contact with the metal.

Soaps which are insoluble in water are less satisfactory in this regard but, in turn, they are beneficial in that they increase the adhesiveness of the oil for steel.

Some metallic compounds possess inhibiting qualities in the presence of moisture.

Slushing oils containing from ten to thirty per cent of a suitably prepared rust preventative mixed with a volatile thinner appear to give excellent rustproofing results. After application the solvent evaporates, leaving a thin layer of rust preventative which is very

adhesive, and which is highly resistant to moisture, thus preventing rust formation. These oils range in viscosity from 35 to 70 seconds Saybolt at 100 degrees Fahr.

however, it has been found that a grayish cloudy appearance, or a yellow or green stain has been caused by the action of certain ingredients in the oils.

Fig. 5—Indicating the effect of finger marks and the type of rust formation (Type No. 5) which may develop through handling of steel materials with damp or perspiring hands.

Where thinners are used, they should have a flash point sufficiently above room temperature to minimize any possibility of fire hazard.

Special rustproofing oils are particularly useful where storage conditions are poor, where steel is exposed to atmospheric temperature changes, and when shipments are to be made in winter when extreme temperature and humidity changes take place, causing steel to "sweat." They are usually specified by customers in order to meet certain of their storage conditions which may be bad, also to meet their particular methods for removal of the oil. The removal of oil is very important; it will be discussed later in this article.

CONDITIONS WHICH MAY CAUSE RUSTING

Investigation of rusting complaints in many steel mills has disclosed that the oil is usually considered to be at fault. In most instances, however, other conditions have been found to be responsible for the trouble.

The basic cause is moisture. In other words, moisture and air must be present for rust formation to develop. Rust is usually reddish-brown in color, although sometimes, especially between sheets of oiled steel, it may assume a blackish hue (due perhaps to the formation of ferrous iron compounds when there is a deficiency of air present). In other instances,

The method of procedure in analyzing any such conditions is as follows:

1. Obtain samples of the original unused oil for laboratory analysis to determine if any moisture or other contaminant is present.
2. Obtain samples of oil from the steel, also samples of the steel showing rust or other deposits. A laboratory analysis of the oil and of the deposit will usually disclose the nature of the trouble.
3. Set up corrosion tests in the plant using the steel and oil under investigation.
4. Observe the processing of the steel just prior to the oiling operation, and also observe the storage and shipping conditions after the steel has been oiled; look for contact with moisture at some point during the interim.
5. Observe methods of handling the slushing oils. It has been found that oils which are handled carelessly are often very apt to become contaminated with water, which is sure to cause trouble.

In order to assist in analyzing complaints, the different types of rust and corrosion observed in steel mills have been classified as shown in the following paragraphs. Illustrations representing each of the eleven types are also shown. Many of these formations are commonly found, and the causes are well

known; other types, however, are somewhat out of the ordinary.

Although these observations were made chiefly in sheet steel mills, the principles involved will also apply to any industry handling steel articles.

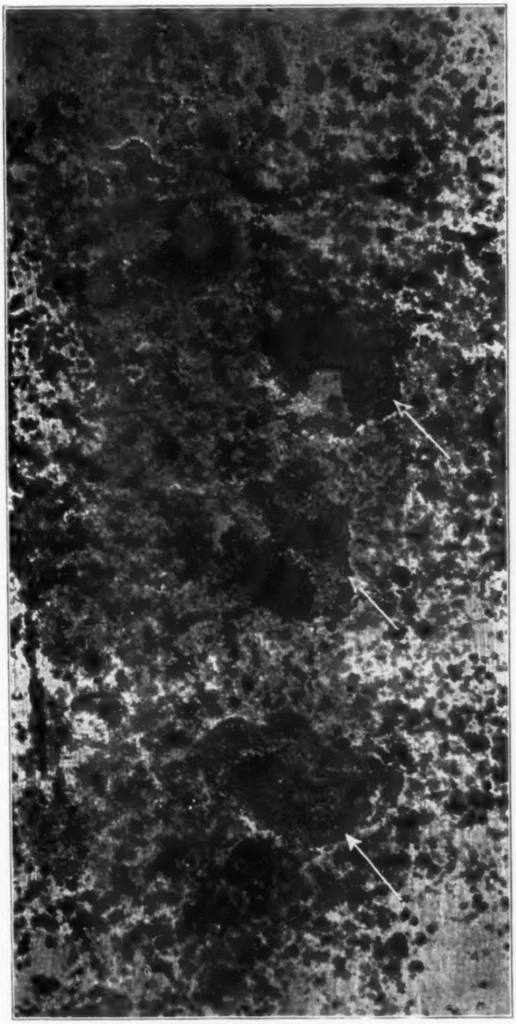

Fig. 6—This shows the Type No. 6 rust formation which is caused by drops of water falling on the steel. Arrows indicate points of heaviest formation.

TYPES OF RUST FORMATION

Type 1—Rust Formation on "Islands" or Bare Spots

Bare spots or "islands" are always present between steel sheets which have been oiled, regardless of the type of slushing oil used. They appear to be air bubbles trapped between the sheets, and flattened out by the pressure, and they form where surfaces are irregular. Oil creeps away from any such bare spot due to surface tension, and only a faint film of oil remains thereon. When rust forms on these spots, it is due to a slight amount of moisture which was present on the steel just before it was oiled. The presence of air and the absence of oil on the spot assist in the rust formation. The method of overcoming this type of rust, of course, is to dry the steel completely before oiling.

In an observed case, steel sheets were given a tempering pass through rolls on which water was played. They were then carried on a conveyor through a live steam drier, and a few seconds later were oiled. After a few days, rust spots began to form on the sheets, especially on the bare spots. Obviously, the sheets were not completely dry before oiling. The method of procedure was then changed; sheets were given a hot air blast immediately before oiling to remove last traces of moisture, and rusting disappeared.

Type 2—Faint Film of Rust Covering Most of Sheet Steel Surface

Caused by steel being incompletely dry before oiling. In this case rust probably begins to form prior to the oiling operation. It can be eliminated by complete drying before oiling. Methods of processing steel differ in every mill; however, in some places steel is washed off with water just prior to oiling, and quite often insufficient heat is applied to completely dry the steel before passing through the oiling machine.

In a case under investigation, steel sheets were pickled, dipped in a tank of boiling water, and then neutralized in a tank of hot lime solution. The racks were set on the floor to drain; the heat retained by the steel was usually sufficient to dry off the pieces before oiling. Occasionally, however, faint film of rust would begin to form before the sheet was completely dry. This type of rusting was eliminated by applying more heat (by open flames) to the steel during the drying period.

Type 3—Rust in Thin Streaks Running in Same Direction

This is caused by thin streaks of salts remaining on the steel following a lime dip after pickling. Even though the steel surface is dried by heating, these salts tend to retain sufficient moisture to cause rust formation directly under the streak of salt.

This type of rust will form within a few weeks, even though the steel is covered with slushing oil, especially if a straight mineral oil is used. Special rust-proofing oils, however, will tend to minimize this rust formation.

In a case under observation, steel sheets were pickled, dipped in a tank of boiling water,

and then dipped in a hot lime solution to neutralize any remaining acid. Thin grayish white streaks remained on the steel after it was dried. Several weeks after oil was applied, rust formed under the white streaks. A careful analysis of the streaks showed them to be composed of lime salts. Apparently traces

Fig. 7—Showing the effect of pin marks on a steel sheet (Type No. 7). These sometimes develop when metal pins in pickling racks come into contact with the steel.

of moisture in the lime caused rust formation. This trouble was overcome by giving the steel a final dip in a tank of boiling water to wash off the lime salts.

Type 4—Heavy Coating of Rust on Outside of Stacks of Steel Sheets and Steel Coils

This is one of the most prevalent types of rust formation. It is caused by condensation of moisture from the air on the cold steel after a sudden rise in temperature. "Sweating" is another term applied to this type. This rust forms when storage conditions are not ideal, and when steel is exposed to atmospheric variations in temperature and humidity. It may form suddenly in winter when sharp temperature and humidity changes take place, or it may form gradually when steel is exposed to slight temperature fluctuations. It can also be formed when steel is exposed to drafts of air. High humidity alone is not responsible for this rust formation. Temperature is the chief factor, because when the steel, for some reason, becomes cooler than the surrounding air moisture will condense on it. In other words, when the temperature of steel is below the "dew point" of the surrounding atmosphere, moisture will collect.

An interesting example of this type of rust formation was observed while a certain steel mill was shut down in the winter and the storage room was cold (approximately 10 degrees Fahr.). A sudden rise in temperature to 60 degrees Fahr., took place one night, and next morning the outside of practically every stack of steel and every coil in the storage room was covered with moisture and rust. This developed even though the steel had been previously slushed with a straight mineral oil; rust formed in spite of the oil. The moisture contained in the warm humid air had condensed on the cold stacks of steel, thereby causing the trouble.

This type of rust formation is prevented in many mills by one or more of the following methods:

1. Keeping the storage room heated in winter to prevent sudden temperature changes.
2. Using one of the "special rust-proof" type of oils for slushing sheets.
3. Painting or spraying the outside of all stacks of steel with a light grease, or with a soft paste type of rust-proof compound. This gives added protection and seals up the cracks between sheets.

Type 5—Finger Marks

Are usually caused by handling steel when hands are wet with perspiration. It has been commonly observed that some operators when handling steel are more liable to cause corrosion than others. This is probably due to the fact that some persons perspire more freely than others, and it may also be caused by slightly acid perspiration which some persons have. This probably would increase the chance of corrosion.

Tool steel is especially susceptible to rust

from this source. It has been overcome in some mills by the following methods:

1. Having operators handle the steel with cotton gloves.
2. Dipping the steel in hot rust-proofing oil

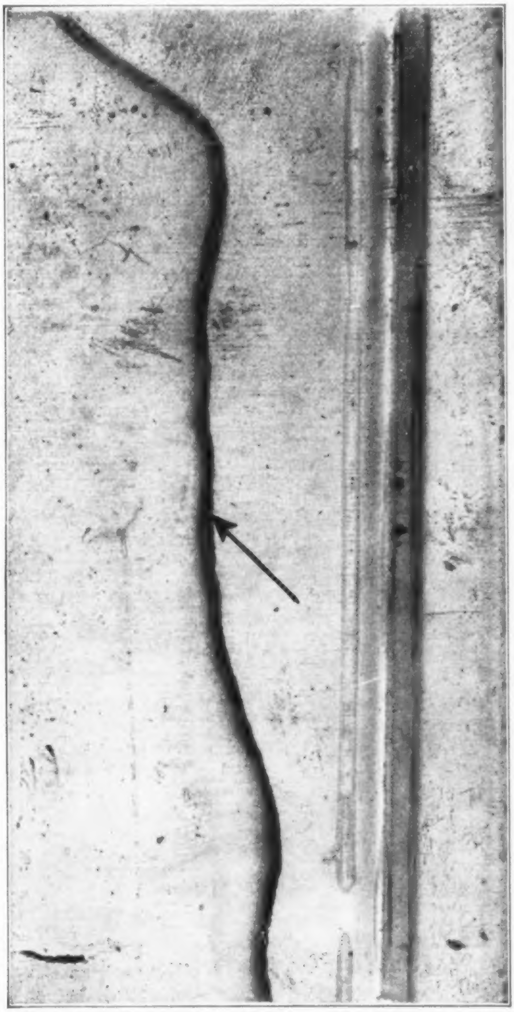

Fig. 8—Type No. 8 rust formation is usually indicated by yellow streaks and designs on steel which has been in storage for a considerable period of time. It is caused by the action of fatty acids which have formed in slushing oils. Arrow indicates one of these streaks.

   The heat removes moisture, and steel is slushed in the same operation.
3. Using one of the "special rust-proof" oils for slushing.

Type 6—Splashes of Rust

These are usually green or brown, and resemble drops of water as they splash on a surface. "Splashes" of rust on steel were found to be caused by steam condensing on the steel roof, and dropping onto the sheets. Drops were acid in nature and very corrosive due to presence of pickling acid fumes in the air.

This type of corrosion has been eliminated in some mills by exercising greater care n handling and storing steel, and by building a protective wooden roof over the location where steel is processed to keep the condensed moisture from falling on the steel.

Type 7—Pin Marks

These rusty marks usually indicate the place where the metal pins in pickling racks touched the steel sheets. This type of rust is quite common, and apparently is caused by a trace of moisture retained under the thin layer of scale. This rust will often develop after sheets are oiled. The use of special rust-proof oil will tend to minimize this type.

Type 8—Yellow Streaks

Several instances were found where yellow streaks and designs were formed on steel which had been stored for several months. Careful analysis of the deposit on the streaks showed them to be composed of iron soap formed by the corrosive action of fatty acid in the slushing oil which had been used on the steel. Certain types of fatty oil tend to oxidize easily and become rancid, forming fatty acids which, upon long contact with steel, will eventually attack the surface, forming iron soaps.

These yellow marks are difficult to remove, and if they are on steel stock which is to be enameled white, they will show through the enamel coating.

Slushing oils containing fatty oils which are easily oxidized are very liable to cause this kind of corrosion. Care should be taken, therefore, in selecting the proper type of slushing oil.

Type 9—Grayish, Cloudy Corrosion with Peculiarly Shaped Streaks

Caused by presence of mineral acid in the slushing oil. This type of corrosion has been observed to form on steel coils within a few hours after they have been slushed with certain types of special rust-proof oils. Analysis of such oils showed that they contained chlorinated compounds. These latter materials had a tendency to decompose under heat into hydrochloric acid. Even though this acid was present only in a very small amount, it was sufficient to cause excessive corrosion in a very short time.

Slushing oils containing chlorinated materials will introduce an objection which must be always very carefully considered.

Type 10—Green Deposit on Copper Coated Steel

Copper coated steel such as is used in mak-

ing automobile running boards often becomes coated, during processing, with a green deposit which is very undesirable, since it hinders subsequent vulcanizing operations. This type of green deposit was found to have been caused when using a drawing compound during the drawing operation containing fatty oil and a sulfurized material. Both these materials will cause a green deposit on the copper in a few weeks' storage.

Straight mineral oils appear to be the best drawing compounds for this type of service, for they will not form the green deposits over a long time of contact with the metal.

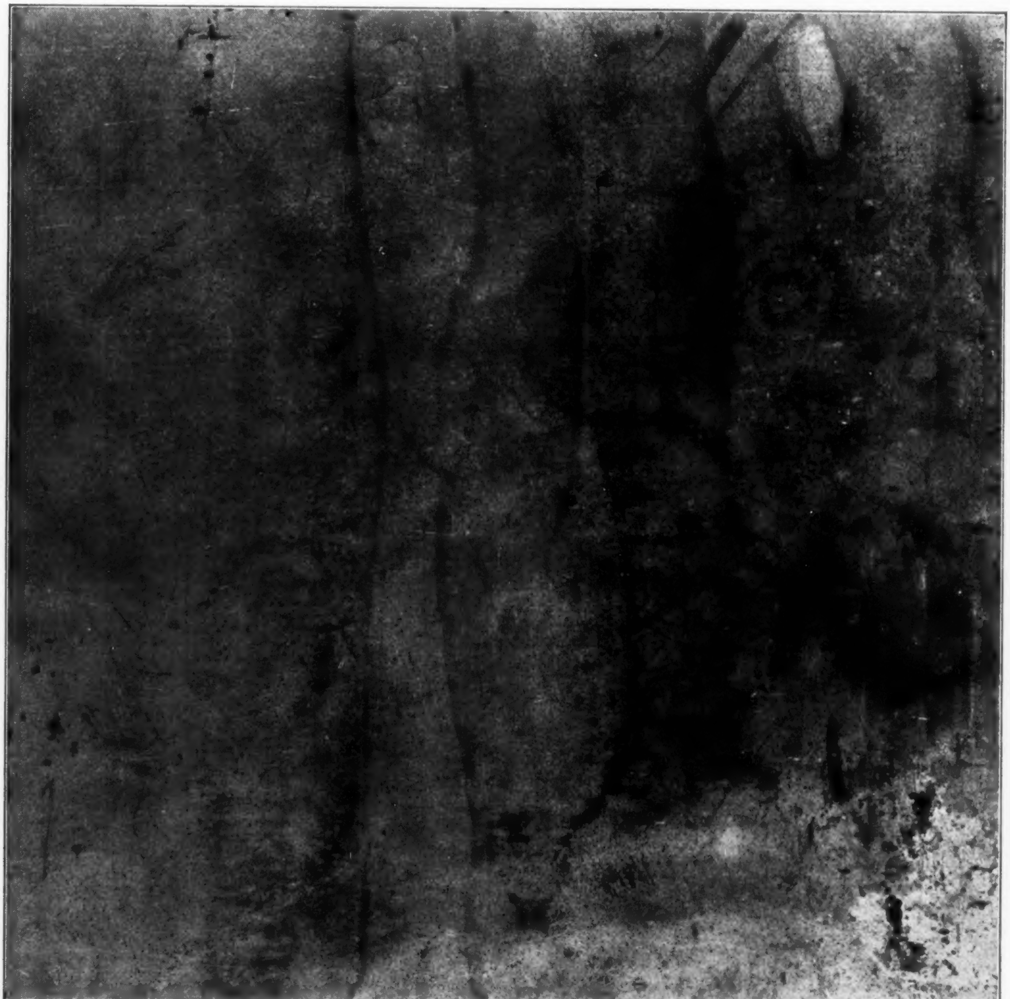

Fig. 9—This type of corrosion or rust formation identified as Type No. 9 shows the grayish cloudy appearance which is evident, and the peculiar shape assumed by these streaks. This is caused by the action of hydrochloric acid formed through breakdown of certain types of slushing oils which contain chlorinated products.

Type 11—Rust Marks on Steel Articles After Processing

Many complaints have been investigated in connection with rust formation on steel articles after they have been processed in plants of steel mill customers.

In many cases investigated, slushing oils were blamed for the trouble, but in every instance a thorough investigation showed that rusting was caused by the presence of water from soluble oil emulsions used in the grinding or cutting operations. The water emulsion was not completely removed from the steel before the slushing oil was applied, and this caused the rust formation. This can be eliminated by one of the following methods:

1. Removing moisture completely from steel by dipping in hot slushing oil.
2. Using a light-bodied straight mineral oil instead of soluble oil emulsions for grinding or cutting operations.

3. Using a "rich" soluble oil emulsion sufficient to protect steel from corrosion.

REMOVAL OF OIL FROM STEEL

A very important consideration in the choice of a slushing oil is whether or not it can be easily removed from the steel when the latter is to be subsequently coated with lacquer or enamel. The three following methods are in general use:

1. Wiping the oil off steel parts by hand with cloth soaked in kerosine.
2. Immersing steel in a hot alkaline solution, or putting it through "washing machines" which use these solutions.
3. Removal of oil by organic solvents, such as tri-chlor-ethylene, which is used in certain types of "washing machines".

Fig. 10—Above is a picture of a section of copper-coated running board on which had developed a uniform green coating (Type No. 10) caused by use of improper types of drawing compounds.

Study of the efficacy of cleaning compounds in the removal of slushing oils from steel surfaces has led to the following conclusions:

1. All types of slushing oils can be removed sufficiently for most subsequent treat-

ment by the hand method of rubbing with a cloth soaked in kerosine.

2. Alkaline solutions will remove all these oils, although the grease types come off with a little more difficulty than the others.

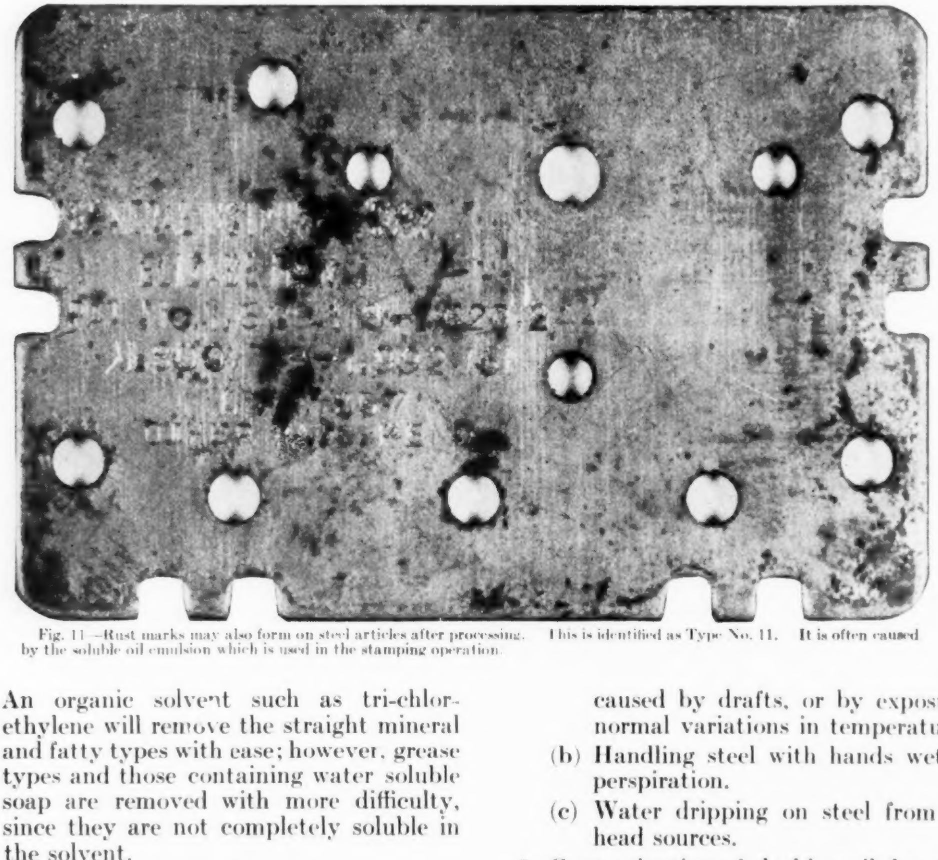

Fig. 11—Rust marks may also form on steel articles after processing. This is identified as Type No. 11. It is often caused by the soluble oil emulsion which is used in the stamping operation.

3. An organic solvent such as tri-chlorethylene will remove the straight mineral and fatty types with ease; however, grease types and those containing water soluble soap are removed with more difficulty, since they are not completely soluble in the solvent.

CONCLUSIONS

The above-mentioned research has led to some interesting conclusions regarding causes of corrosion, rust formation and the effect of contamination of both the slushing oil and the steel surface, viz.:

Causes of Corrosion

1. Moisture getting on steel before slushing oil is applied; it may be due to
   (a) Incomplete drying of steel which has come in contact with water or emulsions during processing.
   (b) Lime or other salts applied during processing.
   (c) Finger marks caused by perspiration of operators while handling steel.
2. Moisture getting on steel after slushing oil has been applied; this may be due to
   (a) Condensation of moisture from the air when steel becomes cooled below the "dew point" of the surrounding atmosphere. Cooling of steel may be caused by drafts, or by exposure to normal variations in temperature.
   (b) Handling steel with hands wet with perspiration.
   (c) Water dripping on steel from overhead sources.
3. Contamination of slushing oil due to
   (a) Water introduced into the oil by improper handling.
   (b) Decomposition of fatty materials in the slushing oils into fatty acids which are corrosive to steel after long contact.
   (c) Decomposition of the chlorinated products which are sometimes used in slushing oils, with resultant formation of hydrochloric acid which is extremely corrosive.
4. The wrong type of slushing oil, viz.:
   (a) The use of drawing compounds containing fatty oils or sulfurized materials which produce green deposits on copper-coated steel.

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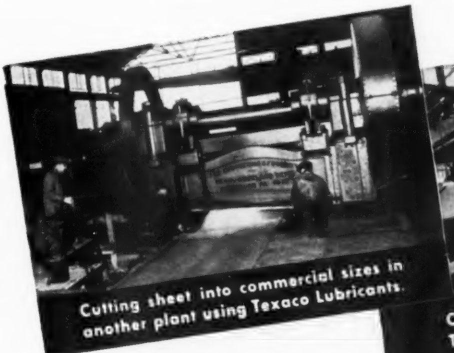
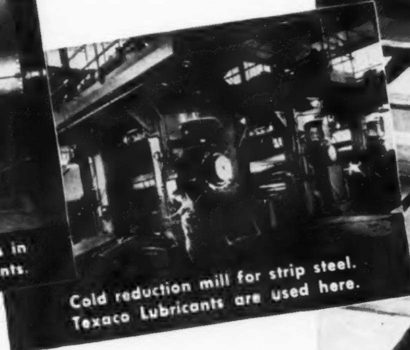
- **Case No. 1*** . . . Switching to Texaco Slushing and Drawing Oil, a large steel mill practically eliminated cracking in sheets used for fenders and auto bodies. The plant reports a considerable economy from use of Texaco.
- **Case No. 2*** . . . Endeavoring to reduce rust-proofing expense, steel men called Texaco engineers who recommended the use of a special oil for slushing, and Texaco Stazon B for sealing of the edges of the stacked sheets. Result: greater rust prevention, greater economy.
- **Case No. 3*** . . . Troubled with rusting of sheets due to failure of various rust-preventing oils, mill called in Texaco. Result: one single Texaco Slushing Oil is now in use throughout the plant, except when the mill's customer specifies a particular oil.



Cutting sheet into commercial sizes in another plant using Texaco Lubricants.



Cold reduction mill for strip steel. Texaco Lubricants are used here.

Steel storage warehouse. Texaco Oils give assured protection to stacked sheets under wide ranges of temperature variations.

Texaco has given intensive study to types, cause, and prevention of sheet steel rust. You can have the benefit of this study by writing direct to The Texas Company, 135 East 42nd Street, New York City, N. Y.

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